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FORMER ISSUES OF AGRICULTURAL JOURNAL.

NOTES FOR LIBRARIES AND RESEARCH INSTITUTES.

So many requests are received from abroad for parts of the *Agricultural Journal* which were never published that the following list of all issues is given for reference. Attention is directed especially to Volume VII which had only one part:—

Vol.			*Vol.*		
I	3 numbers,	1928	VIII	4 numbers,	1935–7
II	4 ,,	1929	IX	4 ,,	1938
III	3 ,,	1930	X	4 ,,	1939
IV	4 ,,	1931	XI	4 ,,	1940
V	2 ,,	1932	XII	4 ,,	1941
VI	2 ,,	1933	XIII	4 ,,	1942
VII	1 number,	1934			

ISSUES OF THE AGRICULTURAL CIRCULAR.

THE following were the numbers and year of issue of the *Circular*:—

Vol. 1, 1920, 12 numbers.
,, 2, 1921, 5 ,,
,, 3, 1922, 4 ,,
Vol. 4, 1923, 1 number.
,, 5, 1924–5, 2 numbers.

As number 4 of Vol. 3 was printed as "Volume 4" and number 1 of Vol. 4 as "Volume 5" it would appear from an inspection of a complete set that Volume 4 comprised only a number 4 and that there were two issues of Volume 5, Part 1.

OLD ISSUES OF AGRICULTURAL BULLETINS.

FREE copies of the following Bulletins are available to Colonial Departments of Agriculture, research institutes and bona fide planters, etc.:—

No.

1. Sisal Hemp in Fiji, 1911.
3. Rhinoceros Beetle in Samoa, 1912.
4. The Banana in Fiji, 1912.
5. Scale Insect on Bananas, 1913.
6. Lemon Grass, 1913.
7. A Mission to Java for a Coleopterous Pest of Bananas, 1914.
8. Coconut Experiments, 1915.
9. Soils of Fiji—I., 1916.
10. Fijian Plant Names, 1918.
11. Alluvial Soils of Fiji, 1919.
12. Leaf Moth of Coconuts, 1919.
13. Sea Island Cotton, 1920.
14. Transparent Coconut Scale, 1921.
15. Purple Leaf Moth of Coconuts, 1924.
17. Early Nutfall in Coconuts, 1930.
18. Control of Coconut Spike Moth, 1935.
19. Fruit Fly Investigations, 1936.
21. Biological Control of the Rhinoceros Beetle, 1941. Price 1s.
22. An Introduction to the Mosquitoes of Fiji, 1943.
    Fijian Plant Names, 1942. Price 3s. 6d., 4s. and 6s.

Applications should be made to the Librarian, Department of Agriculture, Suva, Fiji.

—EDITOR.

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Page 116, last line.—For "eastwards of" read "eastwards to".

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AGRICULTURAL JOURNAL

ISSUED BY THE
DEPARTMENT OF AGRICULTURE, FIJI.

VOL. 14.] MARCH, 1943. [No. 1.

EDITORIAL.

THE first issue of this year opens with a brief summary of the vitally important war work performed by the officers of the Field Division of the Department of Agriculture in 1942 in connection with the production of fresh food supplies for the armed forces. Such production is of the utmost significance to the health and fitness of our troops and the morale of the civilian population and the summary should prove therefore of much interest to all readers. It shows that during 1942 more than ten million pounds weight of fresh vegetables and fruit were grown, collected and delivered to the armed forces. This quantity of food is equivalent to the full cargoes of ten ships each of 6,500 tons capacity.

Those conversant with the very limited labour resources of this small Colony will be well aware of the organization difficulties and persistent efforts that were necessary to assure the gratifying success that was achieved and hence will give full credit to those by whose labours the task was accomplished. In this connection the essential service rendered by the Field Assistants of the Department is stressed, since much of the success achieved depended on their loyalty to their duties and their continued co-operation with the Agricultural Officers despite the manifold distractions existing at the present time.

The hurricane on New Year's Day proved devastating to many coconut plantations in the Colony and sincere sympathy is felt for all those who have suffered such a great setback in their war efforts to increase production of copra which is badly needed for war purposes. The full extent of the damage has not yet been assessed but in the main producing areas of which information is available the loss of crop this year is reported to vary between 30 and 50 per cent and of course, the loss will be continued also in 1944 and is a serious blow to the finances of the producers as well as to the Colony's war effort.

In conjunction with copra grading certain field methods of rapidly assessing the moisture content and free fatty acid of copra samples have been adopted for doubtful consignments and in this issue the Senior Chemist describes the methods employed as devised in his laboratory. His methods are simple and will prove of assistance to copra graders, as well as to those planters who wish to try them for their own edification.

Under copra notes the Senior Agricultural Officer summarises the copra grading figures for 1942 which will be perused with interest by all producers. The summary indicates that approximately half the Colony's production was placed in " plantation grade." In a further note the source of locally produced copra is given, Vanua Levu producing over a third of the total.

In connexion with the increasingly important animal industry, an instructive note on the breaking in of oxen and horses appears in this issue and should prove of interest and of practical value to all members of the farming community. Another note from the Veterinary Division of the Department describes briefly some parasitic worms in birds.

Visitors to the Colony as well as residents will read with interest the note on the sap of a local tree which has a strong blistering action on the human skin which the author indicates to be due to the resinous constituents of the sap.

An article on the cutworm, *Prodenia*, which defoliates the leaves of a wide range of garden vegetables, indicates that it is also a very common pest of dalo and the control measures cited are worthy of study for practical application by gardeners. Fortunately the pest is also checked by a parasite during the egg stage.

Under entomological notes that on the *Anopheles* mosquitoes in the New Hebrides is of topical interest. In 1914 concern was expressed by the Entomologist, that yellow fever might be introduced as a result of the opening of the Panama Canal. So far, the Colony is fortunately free of yellow fever and of malaria; it is also free of the malarial mosquito and the vigorous anti-mosquito campaign now being inaugurated will serve to localise breeding places should this mosquito be unwittingly introduced.

Another entomological note records the capture of a single male of the notorious cabbage white butterfly, after nine years of freedom from this pest. It is hoped that this insect will not establish itself here under existing war time conditions.

Other interesting notes are also included in this issue.

The importance of the local production of vegetable seeds in wartime in isolated islands, is stressed in a note on this subject and all growers are advised to save all their seed requirements as far as may be possible.

An interesting article on incubation of eggs will prove useful to poultrymen.

A review of the revised edition of Paine's *An Introduction to the Mosquitoes in Fiji* concludes this issue which should prove worthy of close perusal.

FRESH FOOD SUPPLIES.

By

H. W. JACK, O.B.E., B.A., D.Sc.

At a recent meeting of the Legislative Council His Excellency the Governor, stressed the national importance of farming and the urgent need for the maximum production of food crops " so that not one ton of shipping nor the life of one sailor shall needlessly be imperilled to bring to us the necessities of life." This has been the objective of the Department of Agriculture since the beginning of the war and through administrative channels, propaganda, co-operation with the Colonial Sugar Refining Company and other means, substantial progress has been made in the production of local food crops to supply military and civilian needs.

Abundant supplies of fresh vegetables and fruit are necessary to keep our armed forces fighting fit and hence the organization of increased supplies for the forces has called for much thought and effort, especially since Japan entered the war. The burden of this highly important work has been carried by the Agricultural Officers, the Produce Inspector and the Field Assistants of the Department and without their staunch and vigorous efforts the satisfactory results obtained to date would not have been possible.

The production of fruit and vegetables for the Military Forces since the beginning of the war has grown from practically nothing in the fourth quarter of 1939, when it approximated 11,000 lb valued at £94, to 3,562,523 lb in the fourth quarter, 1942, valued at £22,893.

A summary of the supply figures to the end of 1942 is shown in the attached table which indicates the materially increased effort made to meet the urgent demands of the American Forces since the beginning of 1942.

Both fruit and vegetables are slightly cheaper in the Western Division than in the Eastern Division where civil demands create more competition but in both areas suppliers are satisfied with the prices fixed for their produce. Fruit has cost a trifle more than vegetables in each Division but a fair average overall price for both may be taken as 1·5 pence per lb. In the Western Division eggs, which are included with vegetables, increased from 145 dozen in the last quarter of 1940 to 2,611 dozen in the third quarter of 1942—the price there has remained steady at 2s. 6d. per dozen.

The Fijians produced about 90 per cent of the fruit and about 60 per cent of the vegetables in the Western Division, and in the Eastern Division about 90 per cent of the fruit and 50 per cent of the vegetables; the Chinese produced most of those vegetables which can be designated as European vegetables. The Indians are substantial producers in the Western Division.

In the year 1942 the total quantity of fruit and vegetables delivered to the armed forces amounted to 10,520,463 lb valued at £65,753, to which must be added £2,760 for firewood supplied through the Department making a grand total for the year of £68,513.

Of this amount it is estimated that the Fijian producers received 55 per cent, the Chinese 30 per cent and the Indians and others 15 per cent. The Fijian market at Nausori supplied 2,959,763 lb valued at £23,030 for the year (including firewood). These figures indicate that the extra food produced for military needs in 1942 was equivalent to the full cargoes of ten ships of 5,600 tons each. This statement reflects much credit on the producers who rose to the occasion with consequent benefit to the Colony's war effort as well as to themselves. The heavy demand for fresh foodstuffs for the military has also stimulated production for civilian needs.

A recent survey of 624 Indian small farmers (of whom 60 per cent had 10 acres or less) in the Central Division (Ba, Tavua and Ra) outside the sugarcane areas revealed the fact that over 95 per cent of them planted half an acre of rice for each member of their families. (See *Agricultural Journal* Vol. 13, No. 4, 1942.) In addition, some 40 per cent of them maintained approximately one acre under other food crops and some 90 per cent of them kept animals (cows, bullocks, horses, goats, poultry). Similarly, Indian small farmers in other non-sugar areas of the Colony also maintained a fair quantity of home-produced food.

Efforts were made to stimulate production of food crops amongst these farmers and amongst sugarcane growers and recent reports from the Colonial Sugar Refining Company indicate that the majority of their tenant farmers are now producing rice where suitable land is available or are maintaining about one acre of fallowed sugar land in a succession of food crops so that home production of food has steadily increased.

Rice imports available to the public in 1942 amounted to 1,422 tons compared with 2,169 tons in 1941 and present indications are that more rice will be grown in the coming season than ever before and, given reasonably fair growing conditions, there should be a record crop in 1943. Efforts to establish more growers on new rice areas (Toga and Seaqaqa) have met with reasonable success—some 279 families having been allotted rice areas of three acres or more through the Department of Agriculture—considering the many distractions of labour in other channels.

The Fijians traditionally produce most of their own food crops and every effort has been made to encourage the maintenance of their food gardens and, despite the attractions of the army and labour forces, native food supplies have been moderately well maintained in most areas up to date, though there are now indications that production may decrease in some areas owing to labour shortage.

Transport of produce and of field staff is causing considerable concern under existing difficult transport conditions which render it almost impossible to purchase any suitable vehicles but the military are assisting as much as can be expected.

The U.S. Forces have been helpful with the provision of vegetable seeds, sprayers and insecticides and the Entomologist and his Fijian assistants have demonstrated pest control methods and paid routine visits to the main vegetable gardens in endeavours to reduce to the minimum pest damage—sometimes amounting to half the crop.

Fish production has recently been stimulated by assisting local enterprise and as a result approximately one ton per week additional fresh fish has reached Suva during the last few months, mainly for the benefit of the military. This venture is, however, severely hampered by the need for a new engine for the transport boat so that journeys can be made more frequently (twice a week) and without danger of loss of fish. A new engine has been ordered for the purpose but delivery is not possible for a few months.

In addition, certain guarantees have been offered in order to encourage additional private enterprise with a view to increasing greatly the fish supply for Suva and to the establishment of a permanent fish supply in the future. Preparations are now in progress to take advantage of these guarantees and it is hoped that a second means of supply of fish will soon be in operation for the benefit of Suva.

In regard to fresh beef supplies, a census of cattle taken in 1941 indicated that there were 84,000 cattle in the Colony. As the estimated slaughter for the civilian population is at present 9,000 head per annum, it would appear that the supply is sufficient for civilian needs though the easily accessible sources of supply have been depleted.

Measures to conserve local beef supplies during the year included two meatless days a week until May 1942, when refrigerator space enabled the armed forces to store their own imported chilled meat. Since October 1941, the slaughter of cows under eight years and other cattle under three years of age and also the speying of cows were prohibited except by licence as a general curtailment of consumption. In addition, the total slaughter of cattle in registered slaughter-houses has been restricted by 10 per cent compared with the average of the six months period May to October. In Suva, this reduction is equivalent to over 20 per cent compared with the month of October (420 animals compared with 330 now). In January 1942, retail prices of meat were raised slightly and in June the wholesale prices of pig meat and beef were increased by 15 and 20 per cent respectively—further slight increases were made in February, 1943.

It is hoped that it may prove practicable to catch and transport to Suva a substantial number of wild (domestic) cattle during 1943 and if this is successful it will materially help the meat situation.

Blood and bone manure is in demand by local vegetable gardeners and materials for its manufacture are available but investigation is hampered by lack of skilled staff and of the necessary standard machinery. It is

hoped, however, to improvise an experimental plant shortly and if it proves successful to amplify it to commercial dimensions since some, at least, of the required machinery is probably available within the Colony.

In order to utilise some of the valuable waste foodstuffs from army camps and to assist in meeting the increased demand for pork, a pig fattening scheme has been designed and piggeries are now being established near Suva where they can be supervised by the Veterinary Division of the Department of Agriculture. It is anticipated that this piggery will provide some 400 pigs annually for civil needs in Suva. Labour difficulties are now tending to curtail pig production, a few producers having already ceased production. With a view to ensuring a permanent market for pig raisers and thus stimulating immediate production it is suggested that a local bacon factory should be established and run on co-operative lines. A number of pig raisers have already sponsored the project and promised financial support to the extent of £1,500 but more supporters are anticipated before a start can be made.

A small supply of fencing wire has been obtained and is being rationed to dairy and stock farmers in order to assist and encourage dairy and beef production. Pigs and poultry of good breeds are also being multiplied on agricultural stations for distribution in order to improve local breeds and build up production.

A surplus of coconut meal, which is of great value as a feed to all classes of live stock, is available in Suva and efforts are in progress to gain increased sales, despite the increased price of the meal in accordance with better copra prices.

Though the improved prices for copra and charcoal have stimulated production effort, the existing shortage of labour on estates has retarded production of these valuable war necessities so that production has not improved materially in 1942. The recent hurricane has proved detrimental to copra production in the main producing areas, the loss being estimated at 40 per cent. for 1943.

Difficulty in arranging for visits to Fiji by experts has retarded practical progress on salt and leather manufacture so far but investigations are proceeding.

Shortage of suitable local timber for butter boxes has been felt so that boxes in shooks have had to be ordered from Canada. Similarly, banana exports have been materially reduced because of lack of locally made cases and none could be made available from New Zealand. Firewood is available but shortage of transport and labour has caused some difficulty in making supplies available.

Labour conditions have become increasingly difficult so that dairying and copra production are adversely affected—butter manufacture is likely to decline. The attractions of labour for the Labour Corps and for Fiji Military Forces have created an acute shortage of labour available to industries in general.

Despite increased costs and other inconveniences it may truthfully be stated that Fiji has been extremely fortunate compared with most parts of the Empire in the matter of supplies of food and other necessary commodities since the beginning of hostilities. Our good fortune, however, is no reason for slackness in the matter of home production of food crops and more and continuous local production is therefore stressed.

FOOD SUPPLIES—ARMY.

SUMMARY—FRUIT IN lb.

Division.	1939.	1940.			
		1st qtr.	2nd qtr.	3rd qtr.	4th qtr.
	Mixed. £ s. d.				
Eastern	93 15 0	3,496	4,689	5,324	60,429
Western*	....	....	....	....	5,300
Total ..	93 15 0	3,496	4,689	5,324	65,729

Division.	1941.			
	1st qtr.	2nd qtr.	3rd qtr.	4th qtr.
Eastern	164,096	18,410	13,147	160,979
Western	8,214	7,721	1,934	17,515
Total ..	712,310	26,131	15,081	178,494

Division.	1942.			
	1st qtr.	2nd qtr.	3rd qtr.	4th qtr.
Eastern	280,424	613,529	772,879	588,303
Western	216,405	647,643	664,057	813,381
Total ..	496,829	1,261,172	1,436,936	1,401,684

* (Includes Nadi, Tavua, Nov./Dec.; Ba, Oct./Nov., 1942.)

SUMMARY—VEGETABLES IN lb.

Division.	1939.	1940.			
		1st qtr.	2nd qtr.	3rd qtr.	4th qtr.
	Mixed. £ s. d.				
Eastern	93 15 0	15,643	20,304	16,291	155,051
Western	....	....	....	....	8,062
Total ..	93 15 0	15,643	20,304	16,291	164,913

Division.	1941.			
	1st qtr.	2nd qtr.	3rd qtr.	4th qtr.
Eastern	127,480	118,580	109,533	120,784
Western	19,108	18,077	22,266	52,245
Total ..	146,588	136,657	131,799	173,029

Division.	1942.			
	1st qtr.	2nd qtr.	3rd qtr.	4th qtr.
Eastern	610,928	870,803	1,083,104	1,094,558
Western	120,908	290,450	796,810	1,066,281
Total ..	731,836	1,161,253	1,879,914	2,160,839

SUMMARY—FRUITS AND VEGETABLES IN lb.

Division.	1939.	1940.			
		1st qtr.	2nd qtr.	3rd qtr.	4th qtr.
	Mixed. £ s. d.				
Eastern	93 15 0	19,139	24,993	21,615	216,380
Western	....	....	....	....	13,362
Total ..	93 15 0	19,139	24,993	21,615	229,742

Division.	1941.			
	1st qtr.	2nd qtr.	3rd qtr.	4th qtr.
Eastern	291,576	136,990	122,680	281,763
Western	27,322	25,798	24,200	69,760
Total ..	318,898	162,788	146,880	351,523

Division.	1942.			
	1st qtr.	2nd qtr.	3rd qtr.	4th qtr.
Eastern	891,352	1,484,332	1,855,983	1,682,861
Western	337,313	938,093	1,460,867	1,879,662
Total ..	1,228,665	2,422,425	3,316,850	3,562,523

Firewood in 1942 has averaged 330 tons per month valued at £230.

MONGOOSE CAMPAIGN.

DURING the month of August last a bonus of 6d. per tail was offered by Government in an experimental effort to reduce the incidence of this pest in the Suva peninsula area.

As a result, 155 mongoose were delivered and paid for during that month but it was believed that about 75 more were killed by interested citizens who did not claim the bonus.

The result of this brief experimental campaign in a restricted area would have been disappointing in normal times but under existing labour conditions the catch was perhaps moderately reasonable.

Much credit is due to those citizens who caught, and who continue to catch, and killed many animals without claiming the bonus.

The experiment was deemed a useful check to the losses of poultry due to this pest in the Suva area and it is hoped that it may be possible to repeat it again on a wider scale in the near future. —H.W.J.

THE DETERMINATION OF FREE FATTY ACID AND MOISTURE IN COPRA.

By
W. J. BLACKIE, M.Sc., F.I.C., F.N.Z.I.C.,
Senior Chemist.

CERTAIN shipments of copra from Fiji have arrived at their destination containing excessive amounts of free fatty acid which, as I have explained in a former article (1) is due to the action of moulds on the copra aided by a moisture content above six per cent.

It is therefore important to know both the actual contents of moisture and free fatty acid in copra for export for the purpose of excluding material that will lower the general standard of shipments and also to act as a check on the analytical results of the oil millers.

The probable moisture and free fatty acid contents can be assessed with a fair degree of accuracy by means of the copra grading methods but it is useful to have accurate determinations made of bulk shipments; moreover, grading methods are difficult with copra from immature or from germinated nuts; such copra is of frequent occurrence in the Colony.

The chemical determinations of moisture and free fatty acid are simple when the facilities of a chemical laboratory are available; however, there is no reason why the normal chemical methods cannot be adapted to plantation practice provided the basic principles are understood and care is exercised during the determinations.

Recently the Department of Agriculture set up a simple testing station at Levuka and the methods adopted there are described for the benefit of interested plantation managers.

Before describing the technique it will be useful to describe briefly the basic principles of the determinations.

The wet meat contains a considerable amount of moisture and oil and smaller quantities of protein materials and carbohydrates. There is little, if any, free fatty acid. The reason for drying is to reduce the water content in order to prevent the development of moulds which attack the oil and split it into glycerine and fatty acids. If the moisture content is kept down below six per cent mould development is purely superficial and the amount of free fatty acid produced is at a minimum. The reduction of the moisture content below five per cent is not economically possible in normal plantation practice but if a sample of copra is shredded so that its evaporative surface is greatly increased it is possible to drive off all the water at steam heat.

The oil in the copra is a complicated mixture of organic acids and glycerol. When moulds are allowed to develop freely they act on the oil and split it into glycerol and free fatty acid. If oil containing fatty acid is intimately mixed with neutral methylated spirit the acids are dissolved by the spirit and if caustic soda is now added in the presence of a dye substance, such as phenolthalein, the acids will combine with the caustic soda to produce soaps. As long as acids are present the phenolthalein will remain colourless but as soon as one drop of caustic soda is added in excess of that required to use up all the free fatty acid a pink colour will develop. If the strength of the caustic soda solution and the quantity added is known, it is possible to estimate the amount of free fatty acid present.

From the above considerations the following simple equipment and chemicals are required.

For the moisture content the requirements are a meat chopper or " mincer " to break up the material, a balance and weights to weigh the sample, metal dishes to hold the sample during drying and a drying oven of sorts to drive out the moisture.

For the free fatty acid we require beakers or some simple glass or porcelain containers in which to weigh or measure the oil, a balance to weigh the oil or a measure which delivers a known quantity; a measuring device to deliver the caustic soda; a standard caustic soda solution and methylated spirit containing the pink dye phenolthalein. The oil used in the process is obtained by a method which will be described subsequently.

The balance required may be of the simple type used in high schools and weighing with an accuracy of five milligrams. A box of gram weights and fractions will also be required. The glass measuring tube for the caustic soda is called a burette and should be fitted with a rubber tube connected to a fine pointed glass delivery tube, the flow of caustic being controlled by a metal pinch cock.

PREPARATION OF SAMPLE FOR ANALYSIS.

About a pound of the copra is roughly cut up with a knife and fed in small pieces to a " mincer ". The material passing through the mincer is collected in an enamelled basin and is thoroughly mixed before samples are taken for analysis.

MOISTURE DETERMINATION.

Two shallow tobacco tins with tightly fitting lids are weighed on the balance and ten grams of copra meat prepared as above are added to each tin.

The tins with the lids removed are placed in a drying oven and the moisture allowed to evaporate. This will take about two hours at steam heat and may sometimes take much longer. The tins are removed from the oven from time to time, the lids refitted and, after cooling, are weighed. Heating is continued until there is no further loss in weight. The final weight is substracted from the original weight of each sample and the difference multiplied by ten will give the percentage of water in the copra. The two determinations should agree closely.

At Levuka the Department has a small double-walled steam copper drier such as is used in chemical laboratories but if care is taken not to burn the sample, the kitchen oven with the door ajar, an electric hot plate at low heat, a small primus stove heating a two inch layer of sand in a basin over which the tins are suspended or any other suitable heating device will serve the purpose. The main idea is to arrange for the driving off of the moisture from the sample without burning or charring.

DETERMINATION OF FREE FATTY ACID.

The free fatty acid is determined on a weighed or measured amount of the oil. For this purpose the oil must be extracted from the sample; a convenient and simple method is as follows:—

After the samples have been taken from the minced material for moisture determination the remainder is squeezed through muslin, the oil being collected in a suitable container. The oil is then filtered through a thin layer of cotton wool placed in a small metal funnel and collected.

A weighed amount of oil amounting to ten grams (or preferably a measured quantity taken from a measure which when filled to a marked height approximates ten grams) is poured into a small enamel pannikin. Three measures of the neutral methylated spirits to which has been added phenolthalein are added and the whole heated almost to boiling point on the kitchen stove or some such suitable heating agency.

The oil methylated spirit mixture is removed from the stove and with stirring, using a piece of wood about the size and shape of a pencil, the half normal caustic soda solution is dropped in slowly until, with vigorous stirring, a permanent pink colour is obtained.

If ten grams of oil are taken and a half normal caustic soda, i.e. a two per cent solution, is used then the amount of caustic soda solution required to produce the pink colour is a measure of the percentage of free fatty acid as lauric acid contained in the oil.

Although the methods are simple, intelligent care is required throughout the operations which cannot be rushed.

Caustic soda solutions should be renewed monthly and it is well to have a pint or two made up and checked by the Government Laboratory at regular intervals.

The methylated spirits should be free from all acid impurities and it would be wise to arrange for this to be done as well as the addition of the phenolthalein in the Government Laboratory.

Using these simple methods, there is no reason why a planter should not determine his own free fatty acid and moisture as a guide to the improvement of his plantation practice. The Government Laboratory will be happy to render any assistance to those who are interested and an invitation is offered to planters and others interested in the copra industry to visit the Laboratory and discuss the details of technique at first hand.

(1) Blackie, W. J.—1941. *Agric. Jour.*, Fiji, Vol. 12, No. 3.

THE PRODUCTION OF VEGETABLE SEEDS.

Vegetable seed for the requirements of amateur and professional gardeners in the Colony is normally imported each season from New Zealand, Australia, the U.S.A. and India. Many growers have always saved their own seed of such common vegetables as pumpkin, watermelon, cucumber, shallot, egg-plant and China cabbage, but seed of french beans, tomatoes and lettuce, though these plants seed freely in the Colony, has always been imported because the strain degenerates very rapidly; tomato plants raised from locally produced seed bear small fruits even in the first generation. Other vegetables such as cabbage, cauliflower, radish and carrot do not set seed under local conditions.

Up to the present it has been possible to maintain imported supplies of New Zealand seed, though delays have occurred from time to time and Suttons strains of cabbage and cauliflower from India—which have given particularly good results in Fiji—are no longer procurable. Nevertheless it may at any time occur that seed orders even from New Zealand or Australia cannot be filled, or that delivery may be delayed beyond the optimum planting season. For this reason market gardeners and others are advised wherever possible to preserve as much seed as they are likely to need from their own vegetable plantings in order that they may maintain production the following season even though imported seed may not be available. This may be done with pumpkin, watermelon, rockmelon, cucumber, shallot, french beans, China cabbage, tomatoes and lettuce, though in the case of tomatoes and lettuce it would be advisable to change back to imported seed the following season, if available, while french beans should not be carried beyond two generations.

Vegetable seeds lose their viability more or less rapidly unless carefully stored and protected against insect attack. Airtight tins or jars should be used, sealed with vaseline; the seed should be well dried before being put away and should not be kept any longer than is necessary —C.H.

THE CUT WORM *PRODENIA LITURA* FABR.

1. DESCRIPTION.

THE olive-brown caterpillar of the Noctuid moth *Prodenia litura* Fabr. has a wide range of host plants on which it feeds either as a cutworm by cutting off young shoots or simply as a leaf defoliator. It is pale green when recently hatched and gregarious in habit congregating on the lower surface of the leaves; later the caterpillars darken in colour and move off to feed independently. The egg cluster is coloured with a buff-coloured protective "down" formed of the fine scales from the tip of the abdomen of the female moth. The pupa is typical being shiny and chestnut-brown in colour: it is found inside an earthern cell two to three inches under the soil. The moth has a wing span of $1\frac{1}{2}$ to $1\frac{3}{4}$ inches with the forewings of a rather complicated brownish-yellow and grey pattern, the hind wings are uniform grey with a dark margin. Certain moths sent to the writer in 1938 from Egypt are on the average slightly smaller than specimens from Fiji.

2. LIFE HISTORY.

The life history occupies approximately one month, the egg hatching in three of four days, the larva developing in 16 to 19 and the pupa in 10 to 11, making a total of 29 to 34 days according to the temperature and amount of food. In the laboratory, leaves of dalo and English cabbage were used and earth provided for pupation. The nocturnal larvæ hide by day under clods of earth, doing most damage by night.

3. DISTRIBUTION.

The insect has a wide distribution outside of Continental Europe (it occurs in Turkey, Cyprus and Crete) where, as in the American continent it is fortunately absent. Some of the popular names given to it in certain countries show the favourite crops attacked, thus cotton leaf worm in Egypt, tobacco caterpillar in the Philippines, tobacco cutworm in the East Indies and tobacco cluster worm in Queensland. Doubtless owing to its destructive habits, wide selection of plants attacked and equally wide distribution it was described as long ago as 1775. An interesting point is that although recorded in Fiji from cotton and rice it apparently has never become a real pest on either of these crops.

4. EARLY RECORDS OF FOOD PLANTS IN FIJI.

The first local record as a pest of food crops appears to date back to 1919 where Veitch referred to it [1] as the Mauritius bean army worm owing to its damaging the leaves of *Mucuna aterrima* Holland as well as leaves of cotton, tobacco and cocoa and fruits of ivi (*Inocarpus edulis* Forst.). The first actual record in the Colony was by Jepson three years previously [2] when it was listed as destroying flowers of ornamental *Begonia*, Eucharist and spider lilies, honey-suckle and crocus and in 1918 it attacked ornamental asparagus. It is interesting to speculate whether this insect did not reach the Colony about the time of the beginning of the last war as Jepson's detailed report published in 1911 [3] could hardly have failed to mention it did it occur then. His "dark green caterpillar with a pale green band" which defoliated tobacco is taken to be *Heliothis armigera* (Hbn).

In 1926 (4) Simmonds published records for the year 1924 of garden seedlings and banana leaves being damaged and previously had dealt with it in more detail (5) listing it from leaves of coconuts, roses, bananas and cannas but did not make the point that the coconut leaflets were never attacked but were simply a surface on which the eggs were laid. This has led, not unnaturally, to *Prodenia* being recorded as a coconut pest in Fiji though this appears not to be the case.

In 1931 the same writer mentioned it (6) as a "plague" along with *Spodoptera* and *Cirphis* but does not record the crops attacked after the floods of that year. Two years later (7) further "plagues" damaged strawberries, cabbages and seedlings early in the dry season. Apparently 1934 was the first year in which dalo, now one of the favourite food plants, was attacked (8) and the isolated locality from which it came—Matuku Island in southern Lau—lends support to the view that *Prodenia* may be a fairly late addition to our fauna. In this connexion it may be mentioned that in Guam dalo was free from insect pests till 1924 when the crops were practically ruined by *Prodenia* and the plant bug *Megamelus* (9), though dalo has, of course, been grown for centuries in Guam and Fiji.

5. RECENT RECORDS OF FOOD PLANTS IN FIJI.

Since the various food plants just mentioned, the writer has taken *Prodenia* from leaves of maize, tobacco, rose, *Asparagus plumosus* besides cabbage (1937) and dalo (1939), the last two from Kadavu. At the present time the chief crops attacked are leaves of cabbage, turnip, lettuce, dalo, carrot, tomato, egg plant and beet root. The last mentioned appears to be a new food plant for Fiji though known in Egypt. (10)

6. BIOLOGICAL CONTROL.

In 1936 and 1937 colonies of the minute egg parasite *Telenomus nawaii* Ashm. were sent to Cairo; this is obviously the common "black Chalcid" recorded for 1924 (4) as being numerous in Fiji but less so than in Tahiti from which it was introduced (5).

A small external-feeding Chalcid, perhaps a *Euplectrus*, was also reared by Simmonds but never generically identified. Among predators the ant *Pheidole megacephala* (F.) was said to be an efficient check on the larvæ and Veitch had previously (1) given the mynah bird and the hornet [*Polistes macœnsis* F.] on larvæ and the same ant as predators on the eggs. Another record by Veitch is the lace wing *Chrysopa sanvitorensi* Navas also on the eggs. The present writer can now add two more larval parasites, viz. a large orange-brown Ichneumon *Campoplex* sp. which emerges from a stout brown cocoon and the Tachinid fly *Sturmia*; a second egg parasite is *Telenomus remus* Nixon. This last was interestingly enough first described (11) from the closely related moth *Spodoptera mauritia* Boisd. in Malaya before turning up in Fiji in 1939, where it occurs in eggs of both moths which are very difficult to distinguish. All recent specimens of *Telenomus* have been determined by the Imperial Institute of Entomology as *remus*, not *nawaii*.

Collecting the egg clusters is tedious but should be encouraged as destruction of anything up to 300 potential caterpillars at one sweep is certainly economic. It is worth the trouble of holding the egg masses in a receptacle to ensure they were not parasitised prior to collection.

7. CHEMICAL CONTROL.

When behaving as a cutworm *Prodenia* can be controlled by a poison bran bait consisting of 25 lb bran, 1 lb of Paris green or white arsenic, 2 quarts of molasses mixed in 4 gallons of water (12). On cabbages in the field it was found that Black Leaf 40 at the rate of $\frac{1}{2}$ fluid oz. in 3 gallons killed *Prodenia* though the spray was primarily aimed at *Crocidolomia binotalis* and *Plutella maculipennis*.

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(2) Jepson, F. P.—1917. Council Paper No. 107. (Report for 1916).
(3) Jepson, F. P.—1911. Dept. of Agriculture, Fiji, Council Paper No. 25.
(4) Simmonds, H. W.—1926. Council Paper No. 36. (Report for 1924).
(5) Ditto —1925. Agric. Circular, Vol. 5, No. 2.
(6) Ditto —1931. Ann. Bull. of Divsl. Reports, Fiji.
(7) Ditto —1933. Ibid.
(8) Ditto —1934. Ibid.
(9) Edwards, C. W.—1926. Rept. Agric. Expt. Station, Guam. (For 1924).
(10) Jinhaku Sonan.—1937. Rept. No. 70, Dept. of Agriculture, Formosa. October.
(11) Nixon, G. E. I.—1937. *Ann. and Mag. Nat. Hist.*, Ser. 10, Vol. XX, October.
(12) Lever, R. J. A. W.—1940. *Agric. Journ.* Fiji, Vol. 11, No. 2, June.

EXTRACT.

TROPICAL DISEASE-RESISTANT PLANTS.

With tropical crops much attention has been and is being paid to the breeding of resistant types. Losses from epidemic disease are likely to be particularly severe under tropical conditions. One of the most notable achievements in the tropics is the production by the Dutch in Java of varieties of sugar-cane uninjured by certain virus diseases, by means of which the output of sugar has been greatly increased. The banana industry in Jamaica and certain parts of Central America is now threatened by Panama disease, caused by a fungus contracted from the soil. There is no known means of control apart from the breeding of a resistant variety. The tropics of the Old World have been ransacked for banana varieties in the hope that some of them would prove resistant to the disease. These were first sent to the Royal Botanic Gardens, Kew, and kept in quarantine there to ensure that they were not afflicted by other serious diseases before being sent to the West Indies. Some of these varieties have proved to be resistant to Panama disease, and geneticists in Jamaica and Trinidad are now using this material for hybridization. It is not, however, sufficient to produce a banana which fruits well and resists the disease; it must also have the valuable qualities of easy and safe transport by sea over long distances possessed by the present Gros Michel variety.

Another disease which is causing concern in the West Indies and contiguous lands is witches' broom of cacao (cocoa) again caused by a parasitic fungus, and again difficult if not impossible to control by the usual means. A few years ago a British expedition was sent into the upper reaches of the rivers Amazon and Orinoco to collect wild varieties of cacao resistant or immune to this disease. The material so collected is now being utilized by plant breeders in Trinidad.

—*Endeavour*, Vol. 1, 3, July 1942. F. T. Brooks.

ENTOMOLOGICAL NOTES.

By
R. J. A. W. LEVER, B.Sc (Hons.), D.I.C. (Lond.), A.I.C.T.A., F.L.S.

1. SHOT-HOLE BEETLE BORERS OF SEEDS AND ROOTS.

THE issue of the *Agricultural Journal* for September, 1941, referred to a Xyleborid found near Mount Victoria in June 1940 inside fallen seeds of dakua salusalu, *Podocarpus vitiensis* Seem. This small beetle borer has now, through the kindness of Dr. C. E. Zimmerman, Entomologist, Bernice P. Bishop Museum, Honolulu, been determined as *Coccotrypes* sp. near *dactyliperda* F. Previous local records of this insect are from palm seeds and dates and as it is also known as a pest of vegetable ivory buttons in Bermuda and New South Wales it is clearly of possible economic significance as a household insect. Approximately one-third of the hard pointed seeds of *Podocarpus* collected at random were found to be badly bored.

Confirmation has been obtained of the hard wood "sacau" as being an undescribed species of *Sideroxylon*, this tree is damaged by *Crossotarsus saundersi* Chap.

The large Bostrychid *Xylothrips religiosus* Boisd., already recorded(1) from large roots of derris, has been checked by storing only roots up to ½ inch in diameter, a practice which is desirable from the insecticidal viewpoint as the finer roots contain more of the active rotenone. In Malaya (2) selection of ¼ inch roots were recommended for the closely related *X. flavipes* Illig. whose habits seem similar to those of *X. religiosus*, also recorded as a serious derris pest in New Guinea (3).

REFERENCES.

(1) Lever, R. J. A. W.—1942. *Agric. Journ.*, Fiji, Vol. 13, No. 3, Sept.
(2) Miller, N. C. E.—1934. Dept. of Agric. S.S. and F.M.S. Scientific Series No. 14.
(3) Dwyer, R. E. P.—1935. *New Guinea Agric. Gaz.*, Vol. 1, No. 1, Oct.

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2. THE CABBAGE WHITE BUTTERFLY.

IN June 1941 (1) an article appeared on the small cabbage white butterfly (*Pieris rapæ* L.) which after being for many years in Hawaii and in New Zealand since 1930 reached Australia in 1939. In June 1931, a male and a female of this insect were taken in flight near Suva wharf, within three days of each other; a female was seen in July 1934, and on January 13th of this year a solitary male was taken on the wing in the same area—the first for nearly nine years. Confusion had arisen over the July 1934 (2) record when a specimen was seen but not captured.

The Entomologist would most appreciate receiving suspected specimens of this white butterfly which is distinguishable from three local butterflies by the presence of unrelieved white hind wings and black tipped forewings not found together in the Fijian butterflies *Catopsilia*, *Belenois* and *Callidryas*. This *Pieris* has been said to be "probably the most injurious of all butterflies" (3) which shows what we would be up against if it were to become established in the Colony.

The velvety green caterpillar has never yet been recorded here; it feeds on cabbage, radish, nasturtium and migonette (4). It has a yellow dorsal line and two lateral rows of yellow spots in line with the spiracles or breathing apertures.

REFERENCES.

(1) Lever, R. J. A. W. 1941.—*Agric. Jour.*, Fiji. Vol. 12, No. 2, June.
(2) *Ditto*, 1939.—*Ibid.* Vol. 10, No. 2, June.
(3) Imms, A. D. 1934.—"General Text Book of Entomology", London, Third Edition.
(4) Smith, K. M., 1931.—"Text Book of Agricultural Entomology", Cambridge.

Aus. 20

WATCH OUT

FOR THIS SPOTTED WINGED

MOSQUITO

At present there is some danger of the introduction into Fiji of an Anopheline malaria-carrying mosquito.

This mosquito is most likely to be *Anopheles punctulatus*.

THE MAIN POINTS OF DIFFERENCE BETWEEN MALARIAL AND NON-MALARIAL MOSQUITOES ARE THESE:

.—Eggs of *Anopheles maculipennis*

.—*Culex fatigans*: egg-boat. (*After Sumbon.*)

(A) EGGS:—

Those of ***Anopheles*** are found singly, have floats and are cigar shaped. Those of ***Culex***, etc., are usually in rafts, have no floats and are not cigar shaped.

(B) LARVAE:—

Those of ***Culex***, etc., hang from the water with only their breathing spiracle above the surface.

Anopheles punctulatus Don

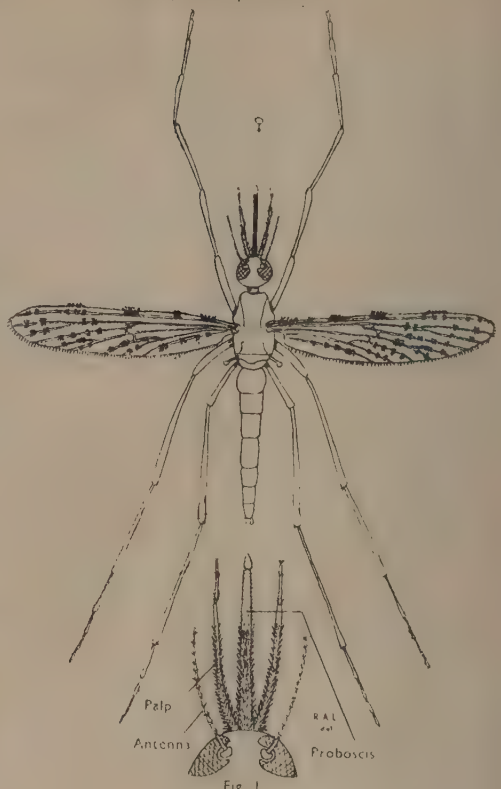
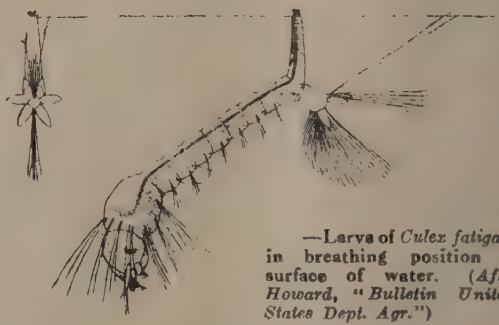


Fig. 1



—Larva of *Culex fatigans* in breathing position at surface of water. (*After Howard, "Bulletin United States Dept. Agr."*)

Those of ***Anopheles*** lie with their bodies parallel to the water surface.

—Larva of *Anopheles maculipennis*, Meigen, showing breathing position at surface of water. (*After Howard, "Bull. United States Dept. Agr."*)

(C) ADULTS:—

Culex, ***Aedes***, etc., resting position: the body and proboscis are approximately parallel to the resting surface. The wings are unspotted.

—Resting position of *Culex fatigans*

—Resting position of *Anopheles sinensis*.

Anopheles resting position or biting position shows body and proboscis in almost a straight line, and at an angle to the resting surface. The wings have black spots.

If you see any eggs, larvae, pupae or adult mosquitoes which you think may be *Anopheles* try and obtain specimens and send them at once to your Medical Officer in the country or to the Entomologist in Suva.

2043—725

3. RECOVERY OF THE FRUIT-FLY PARASITE *MELITTOBIA*.

Owing to the exceptionally late fruiting season due to the heavy rainfall (63 inches from March to May) in 1939 it was impossible in May of that year to obtain supplies of the common fruit by (*Strumeta passiflorae* Frogg.) for breeding the parasite *Melittobia indica* Silv. This Chalcid was introduced from New South Wales in March and April 1938 (1) the name *Syntomosphyrum* then being used, and after 8,000 had been released the stock died out for the above reasons. It was recovered in May 1940, but only 1,700 were liberated and it was feared that it had not become established. However, it turned up again in 1942 being recovered from pupæ of the Calliphorid *Sarcophaga* (*Dasyproctia*) *auricaudata* End. in whose larvæ it matures readily in 16 to 18 days and in that year 1,750 were released.

It is interesting to note that in 1938 up to 35 adults were reared from one Trypetid larva (2), a figure which closely agrees with Dr. N. S. Noble whose maximum figure was 36 in New South Wales (3).

REFERENCES.

(1) Lever R. J. A. W.—1938. *Agric Jour.* Fiji, Vol. 9, No. 3 June.
(2) Ditto—1938. Ibid., No. 3 Sept.
(3) Noble N. S.—1942. Proc. Linn. Soc. N.S.W., Vol. 67, Pt. 3–4.

4.—THE *ANOPHELES* MOSQUITO IN MELANESIA.

Since the publication of an article on *Anopheles punctulatus* Dön. in the Journal for last December,(1) the writer has come across a summary of an interesting paper (2) by three French doctors who worked in the New Hebrides. These investigations were made at the capital, Vila on Efate Island which is about 600 miles west of Lautoka. Larvae of this mosquito were found in water both running and stagnant, in shade and in full sunlight, clear and turbid, fresh and brackish. Sites selected included marshes, slight depressions, along edges of roads, in coconut and cacao plantations, in natural holes and in man-made receptacles. Migratory flights are fortunately very rare and mosquitoes found in villages or in Vila breed in their vicinity.

If these sites are compared with those given in the second paragraph of the writer's recent article (1) it will be realized how many places there would be for this Melanesian *Anopheles* to establish itself were it ever to reach these islands. If only one fertilized female can reach water to lay her eggs that is all that is required.

The leaflet accompanying this number, which is reproduced by courtesy of the Director of Medical Services, shows the difference between the non-malarial or Culicine mosquitoes and the malarial or Anopheline ones at all stages. A mosquito with spotted wings is the harmful one but care should be taken to ensure that it is a true mosquito and not a midge or some other fly. All mosquitoes have a biting proboscis and, except for *Megarhinus*, are small, obscurely coloured insects.

The belief is still held by some persons in Australia that whether the malarial mosquito occurs in this Colony or not, " the presence of the *Anopheles* mosquito in Fiji may be open to doubt " (*Pacific Islands Monthly*, Vol. XIII, No. 4, 17th November, 1942. The seventeen local species are all non-malarial which is in agreement with those competent to give an opinion of the distribution of mosquitoes in Melanesia and Polynesia.

REFERENCES.

(1) Lever, R. J. A. W. 1942.—*Agric. Jour.*, Fiji, Vol. 13, No. 4.
(2) Herivaux, A., Roncin, P. and Daovan Thai. 1939.—Ann. Med. Pharm. Coloniale Vol. 37, No. 1. Paris.

5. MOSQUITOES IN VITI LEVU, DECEMBER 1942 TO FEBRUARY 1943.

During December 1942, and January 1943, two species of mosquito caused a great deal of annoyance in parts of Suva, the common day-biting *Aëdes ægypti* L., which breeds regularly in houses, and the night-biting, periodic *A. vexans* Meig. which although it does not breed indoors is still a pest in houses when it flies in from the ditches, puddles and ponds where it does breed.

The writer had, later in January, to visit certain places in the north-west and north of Viti Levu and here the common mosquito was *Culex fatigans* Wied. particularly abundant in bathrooms at Lautoka, lavatories at Tavua and the rest house and bure at Nadarivatu. This brown mosquito breeds for preference in polluted water, a high rate of organic matter being very attractive. It is interesting that while Suva had, therefore, as the chief offenders two species of the black and white *Aëdes*, localities 60 to 75 miles away as the crow flies had a different genus, *Culex* with *Aëdes* in negligible proportions. It must be mentioned that *C. fatigans* is always present near open septic tanks.

During February collections of mosquito larvæ were made in Suva and neighbourhood and showed that the following five species made up the bulk of the mosquitoes, the breeding places for each being recorded:—

1. *Aëdes ægypti* L.—Tins and drums.
2. *A. scutellaris* Walk.—Rot holes in mango, ivi (*Inocarpus edulis*) and vaivai (*Serianthes*), old tyres, clam shells, soapstone drains.
3. *A. vexans* Meig.—Drains in soapstone and earth and "fox holes."
4. *Culex fatigans* Wied.—Drains in soapstone, pools of dirty water.
5. *C. annulirostris* Skuse.—Drains in soapstone and earth and weedy streams.

It is clear from this that the extra sites provided for mosquito breeding in construction of home-made air raid shelters have been seized upon by one species of *Aëdes* and two species of *Culex* which Paine recorded from barrels, tins, canoes, etc.

The silvery "back swimmer" *Anisops cleopatra* Dist. and Anisopteran dragon-fly nymphs (*Diplacodes* sp.) are predators of the larvæ.

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6. THE *CEROMASIA* FLY OF THE CANE BEETLE BORER IN THE SUVA AREA.

The first example of biological control in Fiji was when the Tachinid fly *Ceromasia sphenophori* Vill. was introduced in 1910, 1913, and 1917 from its original home in Amboina, Ceram and Papua. The pest against which it was liberated was the cane beetle borer, *Rhabdocnemis obscura* Boisd., which did more harm to the softer varieties such as Badila than to the harder Malabar. So far as the writer is aware, the last local account of this parasitic fly was published over twenty years ago [1] when after unrealised fears of its complete failure *Ceromasia* was found to be established at Nausori, a locality with over 116 inches of annual rainfall.

At the end of November, 1942, the writer examined a small, mixed native garden with a plot of cane in Tamavua, some 3½ miles from the centre of Suva, where he found severe local damage by the grubs of *Rhabdocnemis* but many had been parasitised by this fly of which 5, 6, 8 and 12 cocoons were found in four pupal tunnels. Fifteen is the highest number of parasites per host recorded by Muir and Swezey [2] though they showed that the uterus holds up to 570 eggs. Emergence of the flies is prior to 8 a.m. An interesting point was the very light colour of the weevils which are so much paler than others taken by the writer in 1938 on Taveuni Island from

coconuts, as almost to appear a variety were this weevil not known to have a wide variation in colour throughout its extensive range.

REFERENCES.

(1) Veitch, R.—1921. *Agric. Circular*, Fiji, Vol. 2, No. 3, June.
(2) Muir, F. and Swezey, O. H.—1916. Entom. Bull. No. 13, Hawaiian Sugar Planters' Association, Honolulu.

7. INSECT PESTS OF SPICES, FLOUR AND DRIED FRUIT.

STORED products especially seeds, preserved fruit, and cereals are always prone to insect attack and in wartime with its inevitable periods of lengthy storage due to shipping delays these insects are often provided with long periods of undisturbed breeding in almost ideal conditions.

In September 1942 a sample of cumin or zira seeds (*Cumin cyminum* L.) was received from Levuka, Ovalau, so heavily infested with larvae, pupae and adult beetles of *Sitodrepa paniceum* L. as to be unfit for human consumption for which purpose it was being sold. This " drug store beetle " was recorded in 1940 from coriander seeds imported via New South Wales but has certainly been in the Colony for many years as it was recorded from nutmegs prior to 1921.(1) The record of it as a book borer was shewn (2) to be almost certainly due to confusion with *Catorama herbarium* Gorh. In the cumin case the beetles were breeding in the seeds and sieving should have been carried out prior to offering it for sale to the public, for use in curries. No adequate excuse due to shipping delays could be instanced in this case.

Further cases of insect infestation were the so-called lesser grain borer, *Rhizopertha dominica* F. in oatmeal and the rice weevil, *Calandra oryzae* L. in flour, but these were not instances of gross neglect comparable with *Sitodrepa*.

Last November a sample of flour forwarded for examination was found to contain no fewer than four kinds of beetle grubs and one caterpillar, viz. *Tribolium castaneum* Hbst., *Carpophilus dimidiatus* F., *Rhizopertha dominica* F., the minute *Laemophlaeus minutus* (Oliv.) and the moth *Corcyra cephalonica* (St.). Although the bulk of them are well known cosmopolitan insects which have been in the Colony for over twenty years yet care should be taken to keep supplies of cereals in adequate containers to which insects do not have access and this may have to be coupled with sieving. In this particular instance the infestation of the flour was aggravated by the presence of abundant rodent droppings clearly showing that rats or mice had had access to the stock and this is something which to a great extent is easily preventible by even the smallest merchant with the most isolated store in the Colony.

The record of *Laemophlaeus* is interesting as it had not been recorded since 1939 when it was taken in old soya bean seeds.

The rice moth *Corcyra* has been reared locally from stored rice, cotton, maize, linseed, cocoa beans, chocolates and dried apples imported from Australia. A new influx of *Carpophilus dimidatus* F. was brought into the Colony in seed potatoes from New Zealand in November, 1940.

Lasioderma serricorne L. is the well known " cigarette beetle " and has been recorded boring cigars and cheroots for many years. Two new records were in dried bean pods and cabbage leaves which had been prepared for storage as an experimental method of keeping food. Other local records are in coconut meal and dry cotton bolls.

Finally, a tin of dates imported from New South Wales, Australia and sold by a provision merchant in Suva was found in December 1942 to be so heavily infested with the beetle *Oryzaephilus surinamensis* L. as not to

be fit for eating. Larvae and pupae were present and the large number of beetles was clearly breeding among the dates. This insect has been in the Colony for years, one consignment arriving in peach kernels from China in 1938 (3) and in shelled ground nuts from Ceylon in 1940.(4) There were also a few specimens of *Carpophilus dimidiatus* in the dates. Both insects have also been taken in prunes.

REFERENCES.

(1) Veitch, R. and Greenwood, W. 1921.—Proc. Linn. Soc. N.S.W. Vol. XLVI, Part 4, Novbr.
(2) Lever, R. J. A. W. 1938.—*Agric. Jour.*, Fiji. Vol. 9, No. 4, Decbr.
(3) Ditto—1938.—Annual Report of Entomologist.
(4) Ditto—1940.—Annual Report of Entomologist.

8. FURTHER RECORDS AND CONTROL OF VEGETABLE GARDEN INSECT PESTS.

THE following are new records of insects attacking certain vegetable garden crops which have been recorded since the article on this subject appeared in the last *Agricultural Journal*. The numbers of the paragraphs below refer to that article.

2. OTHER CATERPILLARS.

Hymenia recurvalis F.—The whitish larva of the " beetroot worm " attacks spinach and sweet potato leaves which they roll. Pyrethrum or derris dusts as control.

Prodenia litura F.—This voracious caterpillar has since been taken on leaves of turnip, egg plant and beetroot. A full account of this insect appears as a separate article in this issue (pages 11 to 13).

Heliothis armigera (Hbn.).—Much damage is done to many fruits by even one large brown caterpillar of this moth. It bores into fruits of the bitter gourd, *Momordica charantia* L., rendering them totally inedible.

Acrocercops caerulea Meyr.—A small reddish caterpillar which makes superficial mines on the upper surface of bean leaves. The moth measures ¼ inch across the fore wings which are brown with pale spots.

4. SUCKING BUGS.

Brachyplatys pacificus Dall.—This blackish bronze stink bug measures 1/5 of an inch in length and is frequently found pairing on leaves of beans, pigeon pea and *Hibiscus tiliaceus*. The cylindrical white eggs are laid in a double chain and should be destroyed after ensuring that they have not been parasitized by *Ooencyrtus pacificus* Waterst., a small black Chalcid wasp. For the adults, an empty kerosene tin with a few breakfast cupfuls of very soapy water can be held near the affected plants and the bugs jarred into the tin and destroyed at leisure.

15. SPRAYING TABLE.

The following reference table gives suggested amounts for use both in household allotments and larger vegetable gardens:—

Insecticide.	1 *gallon of spray.*	3 *gallons.*	25 *gallons.*
Paris Green	½–1 teaspoonful	½ oz. (plus 1 oz. lime)	¼ lb (plus ½ lb lime).
Lead arsenate. ..	3 teaspoonfuls	1½ oz. (plus 3 oz. lime)	12 oz. (plus 1½ lb lime).
Calcium arsenate ..	10 teaspoonfuls (plus 10 tablespoons lime)	¾ oz. (plus 1½ oz. lime)	6 oz. (plus 12 oz. lime).
Derris (local)	3 oz.	6 oz.	3½ lb.
,, (imported) ..	1 oz.	2 oz.	2 lb.
White spraying oil ..	3 fl. oz.	1 pint (10 fluid oz.)	2 quarts.
Black Leaf 40. ..	1 teaspoonful (plus 1 inch cube of soap)	½ fl. oz. or 1 tablespoonful (plus 2 oz. soap)	4 fl. oz. (plus 1 lb soap).

A NOTE ON THE CONSTITUENTS OF THE SAP OF *EXCÆCARIA* (SINUGAGA).

By
W. J. BLACKIE, M.Sc., F.I.C., F.N.Z.I.C.,
Senior Chemist.

THE tree known locally as sinugaga, and scientifically as *Excæcaria agallocha*, exudes a white sap which on contact with the skin causes severe blistering and may even cause blindness if allowed to enter the eye.

In *Tropical Gardening and Planting*, H. F. MacMillan (1) describes this tree as the blinding-tree and states that on injury it exudes a white, milky, acrid juice which blisters the skin and, further, that it "is held in fear by the Natives of Fiji where the juice is used as a cure for leprosy." Parham in his bulletin *Fijian Plant Names* (2) describes sinugaga as a poison and in general there is a large body of opinion to the effect that the sap of this plant is definitely dangerous.

Recently, several prisoners from the Suva Gaol came in contact with the sap of this tree while they were chopping wood and a number of them suffered extensive blistering of the skin.

A small quantity of the sap was collected and submitted to the laboratory for examination and the opportunity was taken to make a preliminary investigation for the purpose of isolating the active principle responsible for the vesicant properties of the sap.

Experimental.—The sap submitted by the Visiting Medical Officer to the Suva Gaol was milky white in colour and was slightly acid to litmus. This acidity calculated as acetic acid, amounted to 0·174 per cent. The specific gravity of the sap at 15·5° C. was 1·0202.

A quantity of the sap exactly neutralised with dilute sodium hydroxide and acidified with tartaric acid was distilled. No prussic acid was detected in the distillate and therefore cyanogenetic glucosides were probably absent. The distillate was slightly acid and there was evidence of a small quantity of essential oil but volatile aldehydes and alkaloids were absent.

The original sap gave no reactions for aldehydes but there was a slight reduction of Fehling solution.

A quantity of the sap was extracted with ether after the addition of tartaric acid. A small quantity of a resinous material amounting to approximately 5·0 per cent on the original sap was obtained.

The aqueous liquid left after the ether extraction was tested with the normal alkaloidal reagents. Copious precipitates were obtained due, not to the presence of alkaloids but to the presence of proteins in the sap since white precipitates were obtained by saturation with ammonium sulphate on the addition of alcohol to 50·0 per cent strength. The precipitates so obtained dissolved in water and gave strong protein reactions.

A further quantity of the sap amounting to 450 cc. was treated with an equal volume of 95 per cent alcohol and the copious granular precipitate filtered and dried. A sticky gummy mass containing a small amount of rubber was obtained which on extraction with acetone gave resinous materials similar to that obtained by the extraction of the original sap with ether.

All the materials isolated in the course of this investigation were tested by application to the skin of the arm. The original sap caused the appearance of blisters and a burning sensation but the most active product in this respect was the resinous extracts which caused intense irritation and blistering when applied to the skin.

A further quantity of the sap was therefore obtained and after mixing with sawdust and drying the whole was extracted with acetone in a large

extractor. A reddish viscous extract was obtained and this material when applied as a smear to the arm produced the characteristic blistering and burning.

Further investigations are proceeding in regard to the constituents of this resin with the object of arriving at the nature of the active vesicants.

Summary.—A preliminary investigation of the constituents of the sap of Sinugaga indicate that the vesicant properties of this sap are related to the contained resinous materials.

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(1) MacMillan, H. F.—1925. "Tropical Gardening and Planting." Ceylon.
(2) Parham, B. E. V.—1942. "Fijian Plant Names." Department of Agriculture, Fiji.

VETERINARY NOTES.

PARASITIC WORMS FROM BIRDS.

By
H. T. B. HALL, B.V.Sc.

1. A GAPE WORM FROM POULTRY, *SYNGAMUS TRACHEA*.

The gape worm, *Syngamus trachea* (Montagu 1811) has been found in the trachea of fowls in Suva. The parasite was first seen on 15th December, 1939. The locality concerned was a small fowl run on the outskirts of Suva. Although widely distributed throughout most of the countries of the world this is the first recorded instance in Fiji.

Since the above date the parasite has been found on another small fowl run close to Suva.

2. TAPEWORM OF BIRDS, *HYMENOLEPIS* SP.

A TAPEWORM which was found in the small intestine of a mynah (*Acridotheres tristis*) on 13th January, 1941, has been submitted for identification by the Government Entomologist, Mr. R. J. A. W. Lever, B.Sc.

The worm is a member of the genus *Hymenolepis* but does not correspond in appearance with the member of this genus occurring in man in Fiji (*H. nana*).

The genus *Hymenolepis* contains a large number of species which occur chiefly in birds. Bayliss* describes numerous species occurring in domestic birds but the present specimen is not identical with any of them.

* Bayliss, H. A.—1929. "A Manual of Helminthology, Medical and Veterinary."

REVIEW.

"INTRODUCTION TO THE MOSQUITOES OF FIJI", 1943.

THIS is the second edition of Mr. R. W. Paine's paper, first published in 1935, and now issued as Bulletin No. 22 of the Department of Agriculture. It has been slightly revised by the Entomologist but is actually the same paper for which there has been a steady demand for years.

Details of the breeding places of the 14 indigenous and two introduced mosquitoes are given (one species was taken for the first time in 1940) as well as keys for identifying the larvæ and adults. Ten of the commoner species are dealt with at some length and there are hints for collecting, definitions of technical terms and three pages of illustrations.

The name of mosquito No. 5 on page 9 is *Tæniorhynchus* not "*Tænuirgthcgys*" as printed.

—R.J.A.W.L.

INCUBATION OF EGGS.

By
C. R. TURBET, B.V.Sc., M.R.C.V.S.,
Senior Veterinary Officer.

1. GENERAL.

THE eggs of domestic poultry may be hatched either naturally by the heat of the body of the hen sitting on the eggs, or artificially in an incubator.

Natural incubation is the easiest method when only a few eggs are to be hatched and is most suited therefore to those who keep fowls or ducks in small numbers. Under such circumstances it is also the cheapest method since there is no expense incurred in the purchase of machine or fuel.

For the poultry farmer, however, natural incubation is impractical. Too many hens are thrown out of production if used as broodies or sitters and large numbers of nesting boxes are also required. It is much more economical for the farmer to hatch eggs in small incubators which are obtainable in sizes varying from 50 eggs to several hundred egg capacity. The use of one or more of these machines is recommended for poultry keepers with 50 or more laying hens.

A further development of the incubator is that known as the commercial incubator which is a very large machine, holding even thousands of eggs. There are none of these machines yet in Fiji. The owner or operator of a commercial hatchery is more or less a specialist who hatches eggs only, usually for sale as day old chicks. He does not as a rule raise fowls for egg production or sale of table birds.

The time required for the incubation of eggs of different kinds of domestic bird varies considerably but the average incubation periods are as follows:—

Hens	21 days	Pea fowl	28 days
Guinea hens ..	25 ,,	Geese	30 ,,
Runner ducks ..	28 ,,	Muscovy ducks ..	35 ,,
Turkeys	28 ,,	Pigeons	18 ,,

In warm weather eggs hatch earlier than in cold weather and newly laid eggs hatch in a shorter period than older eggs. The period for hen eggs may be as short as 19 days.

Only eggs from sound breeding stock should be used for hatching. They should be as uniform in size as possible and of good shape. Shells showing thinness of shell, ridges, or porous spots should be discarded, as should be oversized, undersized or cracked eggs.

Turning of Eggs.

Eggs being kept for hatching may be kept on their sides or in racks with the small end down; the former method is probably the better. If kept on their sides they should be given a quarter of a turn once or twice daily. If kept on their ends the rack should be tilted at different angles daily. The reason for turning is to prevent the yolk floating up to the surface of the white where it would stick and eventually cause the death of the embryo chick.

Age of Eggs.

Up to seven days old eggs retain their full ability to hatch. Between seven and twelve days ability to hatch declines. One should endeavour therefore to set eggs as fresh as possible and it does not pay to set eggs at all after twelve days. The only justification for doing so would be in the case of eggs of pure bred stock ordered by post, the delivery of which has been delayed.

2. NATURAL INCUBATION.

Nests.

If in a position sheltered from the weather and animal pests, nests built on the ground give good results as the moisture and warmth of the ground is favourable for good hatching. In Fiji better results are obtained by building the nest in a box in which a layer of slightly damp earth has been placed. The box should be slightly raised off the ground to prevent flooding and excessive dampness in wet weather. In forming the nest, first make a shallow saucer-shaped depression in the soil and cover this with dry grass or fine wood shavings.

The nest box should not be smaller than 12 inches square but slightly larger boxes are desirable in the tropics to give good ventilation. Excellent nesting boxes may be made from small trade boxes; the top of the box is better closed, leaving the opening in the side. To retain the nesting material in place, a board about three inches high should be nailed across the lower portion of the front opening. If the box is placed in the open it should be provided with a slatted or netting covered door. Should the nesting boxes be arranged at a height off the ground, alighting boards should be placed in front of the nesting box for the use of the hen when leaving or entering the nest.

Nesting boxes for setting hens require protection from laying hens; such boxes should preferably be placed in a house or run to which laying hens do not have access.

Setting the Hen.

Before setting a broody hen she should be well dusted with pyrethrum banana powder to free her from lice. If this is not done the hen may leave the nest before the hatch is completed because of the worry caused by the lice.

Have the nest prepared and if dummy eggs are available it is a good plan to place these only in the nest for a few days to allow the hen to become well settled. Whether dummy eggs or real eggs are used, night will be found the best time to set the hen since hens set during the dark usually settle down well.

The usual number of eggs that may be set is 13 but with small hens the number may be reduced to as low as 10. It is seldom that more than 13 can be set.

Darkness during the first few days helps the hen to settle down and for that purpose sacking or a wooden frame may be used to cover the front of the nest.

An economical way of setting large numbers of eggs is to set several hens on the same night. After seven days the eggs may be tested by candling (see paragraph 3) to detect infertile eggs and chicks dead in the shell. After discarding such eggs the remaining eggs may be redistributed to make up full numbers under some hens whilst fresh eggs may be set under the hens which have now no eggs left.

Fresh water should be available to setting hens. Food is best fed dry and should be placed ready for the hen when she comes off the nest. She will then quickly take her food and water and return to the nest without undue delay. Shell grit and pebbles should also be available.

Whilst the hens are off the nest the latter should be inspected for broken eggs and soiled nests. Broken eggs should be removed and if necessary the litter renewed.

Every hen is not a good setter; generally speaking, light breeds such as the Leghorn are useless, and pullets do not set as well as mature hens. The medium and large breeds set well but probably the best setter is the game

and crosses with the latter breed. Some hens are clumsy and break their eggs whilst others leave the nest too often. By careful observation these hens may be detected and replaced by more reliable hens.

Lice and mites are the enemies of setting hens. If these are present the hen will most likely leave the eggs. In addition to keeping the hen clean and free from these pests the nest also requires careful inspection. Before using a nesting box a second time the old nesting material should be discarded and the box washed thoroughly and disinfected by flaming or by disinfectant fluid.

Allow good ventilation and have the nests built in a cool place. If under an iron roof it is wise to place cut grass on top of the iron to keep down the temperature.

When hatching commences do not worry the hen by too much interference. Broken shells may be removed by running the hand under the hen so as to give more room. Do not remove the hen to the brooding coop until the chicks become very active and commence to leave the nest of their own accord.

3. ARTIFICIAL INCUBATION.

When the hatching of eggs by natural incubation under hens ceases to be a pleasant hobby by reason of a large number of hens being set and the consequent almost constant supervision they require, then the purchase of one or more incubators is warranted and in fact, an essential equipment of the small poultry farmer.

There are many makes of incubators on the market, most of which are efficient machines. It is often better, however, to purchase a machine of a make whose efficiency has been proved under local conditions by someone known to you.

The price of machines varies from about six pounds to twenty pounds according to the size. When deciding on the size of the machine required, be guided by the number of eggs it is estimated may be collected in seven days. To keep up a continuous programme of breeding it would be desirable to have three such incubators, one being loaded about every eight days and a batch of chicks coming out with the same regularity.

Housing.

It is preferable to house incubators in a separate room, the temperature of which may be kept reasonably uniform. There should be good ventilation without noticeable draught. The sun should not shine directly through a window on to an incubator so it may be necessary to shade the window by a curtain or by painting the glass. The incubator should stand level on a firm floor of wood or concrete.

Operation.

Directions are usually supplied by the makers of incubators for the operation of that particular make of machine. These directions should be closely followed. If best results are to be obtained, proper control of temperature, air circulation, humidity, turning of the eggs, cooling of the eggs, and the removal of infertile eggs or eggs with chicks dead in the shell should be assured by close attention to the directions given. A written record should be kept of all observations in relation to the above essentials in operation.

The source of heat in the usual small incubators is derived from the burning of a kerosene lamp. The heat is transferred to the incubation chamber either through the medium of a hot water jacket or hot air. All incubators are fitted with some form of mechanism to regulate the amount of heat and to keep the temperature in the incubation chamber constant within narrow limits.

If the air within the incubator were allowed to become dry, rapid evaporation of moisture from the egg would occur resulting in the death of the embryo chick. Incubators are fitted with water containers or some other device whereby a high degree of humidity may be maintained within the chamber. If loss is to be avoided it is very necessary to fill the water containers according to the directions for operating the particular machine.

Cleaning.—After each incubation and before being reloaded with eggs the movable parts should be taken out and thoroughly washed with warm water containing weak disinfectant and dried in the sun. The floor and walls shoulds be well cleaned and may be sponged with a damp cloth, using a mild disinfectant fluid. Care should be taken not to use strong disinfectants in the incubation chamber. All encrustations should be carefully scraped off before final washing.

Temperature.—The thermometer within the incubator should be adjusted so that the level of the mercury bulb is just clear of the eggs. Before loading the machine run it for from one to two days to make sure that the temperature is correctly adjusted to 103° Fahrenheit. Having once adjusted the temperature control gear, do not hasten to alter it to correct temporary small variations fron 103°. Inspect the thermometer frequently; adjustment becomes necessary only if the temperature remains constant higher or lower then 103°.

Testing.—No amount of skill in incubator construction or operation will provide for one hundred per cent hatching. Assuming that the incubator is as perfect as human efficiency can make it, and most incubators are efficient machines, two factors affect the hatch, firstly the quality of the egg and its ability to hatch and secondly, the attention to detail in operation of the machine. Some eggs will be infertile and in others chicks, from different causes, will die. Both types of eggs are dangerous to other eggs on the trays, since the putrefaction of such eggs is likely. Eggs lying alongside of the affected dead eggs are almost certain to become infected and die. It is necessary, therefore, to inspect the eggs in the incubator periodically to detect such eggs and to remove them. This is done by a process called candling or, in other words, by viewing the eggs against a restricted lighted background in dark surroundings.

The first testing is done after seven days incubation. At that time it is possible to detect infertile eggs, distinguishable by their clearness except a floating shadow—the yolk. The dead germ may be recognized by the absence of the blood vessels, its adhering to the shell, or by the pinkish ring surrounding it, which is referred to as the blood ring. The live germ is spider-like in appearance during the first few days, the body of the embryo representing the body of the spider and the radiating blood vessels its legs. The live germ floats about freely in the contents of the egg when the egg is rotated before the tester.

The second test is made at the end of the second week. All remaining eggs containing dead germs should be removed at this time. The live embryo by this time appears nearly to fill the egg. After some practice and experience, incubator attendants are able to detect by their colour the difference between eggs containing live embryos and dead.

Turning the Eggs.—This should be done at least once daily. Trays may be turned about to equalize any difference in temperature within the chamber. No turning is required after the eighteenth day in the case of hen eggs. In small incubators there is no mechanical means of turning the eggs. So it should therefore be done by hand. A quarter turn for each egg is sufficient.

Cooling.—In natural incubation, hens leave their eggs periodically to take food and water. During this period there is a certain amount of cooling of the eggs. In artificial incubation a similar cooling period should be allowed. The trays are removed entirely from the machine and placed on a table near by where they are allowed to remain for a varying number of minutes. In this regard it is probably best to follow the direction for cooling as supplied with the particular make of incubator. Some operators use what is known as the eye test. In this test the small end of the egg is held to the eye and when it feels barely warm it is considered that sufficient cooling has been given. Eggs cool more rapidly early in incubation than later since as the embryos grow they themselves develop heat.

Hatching.—After the eggs pip the incubator should not be opened again until the hatch is over. This will be evidenced by no more wet chicks appearing on the egg trays. These may then be removed. If the chicks in the nursery tray pant, the incubator door should be wedged open enough to stop the panting without cooling the chamber sufficiently to cause the thermometer over the egg tray to fall below 100°F. The egg chamber should be kept dark to keep the chicks quiet.

Twenty-four hours after the hatch is completed the chicks can be moved to the brooder.

The best results from incubation are to be expected in the cooler months of the year from May to October. This article appears, therefore, in time to assist those inexperienced in the art so that the greatest possible number of chicks may be raised in the coming season.

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THE BREAKING AND TRAINING OF ANIMALS FOR FARM WORK.

By
R. N. SANDERS, B.V.Sc.,
Veterinary Officer.

1. BULLOCKS.

THE average peasant farmer in Fiji is usually successful in the breaking in of working bullocks. This is perhaps one of the least abused of animal management practices among them and is due to the fact that the majority of farmers tether their calves almost as soon as they are born. When the mother dries off the calves are usually herded during the day and penned at night. At three years, and sometimes earlier, a nose rope is inserted and the animal is taught to be driven. After this it is paired up with another young bullock or an old beast trained for work.

However the breaking in of bullocks that have not been handled or penned leaves much to be desired. Too frequently one sees an animal caught in the hills, manhandled until it is tied between two quiet bullocks and dragged by them, sometimes for miles, to a post, where it is chained for several days and starved into submission. Breaking in is not a matter of breaking an animal's spirit, but the art of teaching it to do what is required. It takes time and patience to teach properly and some animals will respond quicker than others. The successful breaker-in is patient and kind, but firm.

The wild animal, especially if it has Zebu blood, is to the average farmer with his lack of facilities a problem, but it can be overcome without resorting to the brutalities in vogue. Even the larger Indian and Fijian cattle owners who mostly break in this class of beast do not possess good yards. Without a good yard the wilder type of animal is very difficult to break in properly. A good solid yard can be built cheaply out of bush timber and use of the wire twitch. Probably nowhere will one find so many animals with less respect for fences as in Fiji, nor will one find animals so scarred as in Fiji. This is mostly due to the fact that the animals are not properly broken in and that the yards in which they were broken were very flimsy and primitive arrangements.

It is hoped that the following notes may prove serviceable.

Once the animal is in a good yard a nose-rope should be inserted. This will cetainly involve manhandling, but avoid as much cruelty as is practicable, and complete the task quickly. Have the rope prepared for insertion before the animal is thrown. Probably no farmer has a nose punch, and it is suggested that the best method for the average farmer is the use of a sharp packing needle through which the rope is threaded. The rope, nothing heavier than one inch, is prepared by unwinding the strands at one end for about one foot. Each strand is unravelled and scraped with a sharp knife until it tapers to a point. The strands are then twisted together again finishing with a rope the end of which tapers to the thickness of very fine string. The rope is waxed and threaded through a sharp pointed packing needle which is then passed through the non-cartillaginous part of the nasal septum carrying the rope with it. This method, by no means perfect, is preferred to some of the frightful attempts with knives and hot irons that have been witnessed.

The animal is left for a week or so in order to give the raw edges of the nasal septum a chance to heal. A lead rope is then tied to the nose rope and the bullock is made to accustom itself to being tethered. Whenever the beast is fed, and it should be fed well and regularly, attempts should be made to handle it. At this stage patience, kindness, and firmness will prevail with the vast majority of wild bullocks.

Once the bullock can be approached and will permit being stroked, it should be taught to lead first in the yard and later outside. Some people prefer to do this by coupling it with a broken in animal, and with some beasts this method is preferable.

At this stage the breaking in can progress more rapidly. The animal is lead past farm implements, and is also tethered close to other animals which are working. When it will lead both singly and coupled, it is placed in the yoke first without the chain and later with the chain dragging. Once accustomed to this, harness to an empty sledge and as soon as the bullock is pulling smoothly place a few bags of sand or earth on the sledge. Avoid undue noise and overloading. After a week of sledge pulling the bullock should be ready to be yoked to the plough. At first give it only a few minutes ploughing but gradually lengthen the period until it can work all day.

As it is seldom that working bullocks in Fiji are used solely for cart work, it is better to accustom them to ploughing before attempting to put them in a cart or hauling cane trucks. Once they have steadied down to the plough, or at least have had a lot of sledge pulling, have them yoked either to the cart or to a few cane trucks, but only after they have grown accustomed always preferable to have them partly loaded and on a slight up grade before to the noise of moving trucks and carts. In the case of cane trucks, it is permitting young bullocks to pull empty trucks on the level.

The biggest mistake made by the average farmer is to expect the three or four year old animal that has had little or no handling to be broken in as quickly as the beast that has been handled and tethered since it was born. The latter can be broken to the plough in one or two weeks while the former frequently takes as many months. Another common mistake is to interpret fear and attempts at self defence as viciousness or stubbornness, and the farmer only adds to this fear by starvation and other cruel methods.

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2. HORSES.

While many peasant farmers in Fiji break in their own working bullocks, comparatively few attempt to break in their working horses until at least the animal can be handled a little and led. The breaking in is mostly started by the breeder or dealer, who leaves the breaking to harness and work to the farmer. If the average farmer in Fiji realised the pleasure and saving of time and fatigue of working a properly broken in team, he would refuse to buy any horse that he knew had been choked, starved, and beaten about the head. He might also be more careful himself with the completion of the breaking in process. The dealers and breeders are generally not interested in the future of the horse, and, knowing that the farmer is not worried as to how the animal has been treated previously, resort to many forms of brutality until the horse can be led to a farmer. The latter has bought a horse and feels that the sooner it is working the better, and so, irrespective of age or the amount of training the animal has already had, harness it to a plough. This is invariably done only after much damage has been done to both horse and implement. What the cuts and bruises of the implement do not teach it, beatings with a heavy stick will. The result is either a badly scarred impossible beast, or a similarly scarred " broken " beast. Both are difficult to work and cause man and beast a lot of unnecessary fatigue. The object of breaking in is to train the animal. Fortunately a lot of the more progressive peasant farmers are now beginning to realize this, and are trying to correct the mistakes of the past.

As with the breaking in of bullocks, good yards are essential for the proper training of horses. The horse trainer to be successful must be more intelligent and patient than the bullock trainer. The " breaker " of horses only partly succeeds with his starvation and beatings after a long and hard fight, and then finishes with a " broken " animal, whereas the trainer will have a contented animal working in half the time.

Attempts should be made early to handle the animal. The best method is to gain its confidence by approaching slowly and speaking to it quietly. Repeat this until its nose, head, and neck can be patted, then place a rope on it. Some horses will have to be roped first, but this should be avoided as much as possible. If a rope has to be used do not choke the horse into submission with a slip knot. A slip knot with a chock may be used, but only if it is essential. If the horse must be roped, gradually work one hand along the rope towards the nose holding the loose rope in the other hand.

After the horse can be handled in this manner put on a bridle, adjust it to fit, and leave it on except when feeding. When accustomed to the bridle, or head collar, attach a rope and start the lesson of leading. At the same time extend the patting down the neck and shoulder over the remainder of the body finishing with teaching it to permit its feet being lifted. When doing this have another reliable person to hold the head on whichever side you are working. The rope is then lightly drawn across the different parts of the back and rump.

Now attach long rope reins to the bit and commence driving the horse around the yard teaching it to turn and finally to back. Avoid vicious pulls on the reins, thrashings, and shouting. Be patient and after a little encouragement it will move forward. Again do not mistake fear for stubbornness, when, attempting to drive it for the first time, it refuses to move. If it will not move after several attempts at verbal encouragement, give it a light flick with the reins or a long light stick. The use of the word of command is preferable to the rein in a farm animal. This is very much abused in Fiji where a mighty tug at the rein suffices. Horses can learn words of command, which, together with a light touch of the reins, is all that is needed to guide the average horse. The actual commands matter little except where the horse is likely to pass through several persons' hands. If the command is to be used be consistent with it. Thus even in Fiji the usual word used to make a horse go forward or to stop is " gee up " and " whoa." Very seldom used are words such as " gee off " and " gee over " to make a horse turn to right or left. " Whoa back " is commonly used to back a horse. The important thing is to speak quietly, avoid tugging at the reins, and only when necessary flick with a light stick. When turning or backing only slightly increase the pressure, which should never be great, on the rein or reins.

Once the horse has mastered all this in the yard take him out into a paddock and give him several lessons there. At this stage it should be possible to put on a collar which is attached to the back band by means of rope. The hames and chains can be put on after a very short while. If he is to be broken in for a cart then the cart harness can be put on him. Once accustomed to these, whether the horse is to be used solely for cart work or not, harness him to a sledge and, walking behind, put him through the routine of starting and turning. As soon as the horse ceases to be afraid of the sledge place a light load of bagged earth on it. For the first day or so the horse should not be allowed to pull the weighted sledge for longer than half hour periods, after which the weight and time can be increased gradually.

The horse should now be ready for the plough or cart, but before placing it in either, accustom it to see and hear moving farm implements. For the plough horse it is generally as well to give it a few hours coupled with another horse after which there should be but very little difficulty to get it to work in the plough. Special carts are used to break horses in to the cart. These have longer shafts and are lighter than normal, but very few farmers or breakers in Fiji could afford to have such special vehicles. Such carts are chiefly to prevent damage to horse, cart, or driver if the freshly trained horse should take fright. Before harnessing the horse in a cart always walk him over the shafts several times and teach him to back between them.

Never work the newly trained animal for long periods, nor give it very heavy loads. Commence with small loads pulled for a few minutes, and gradually allow it to get used to working, as well as giving its skin at the shoulder and other parts where harness is bound to rub for a while time to harden up.

CHEMIST AND SOLDIER.

In a fairly short space of time you can, if need be, turn a chemist into a fighting man but you cannot turn a fighting man into a chemist.

SIR HECTOR HETHERINGTON, Vice-Chancellor,
University of Glasgow.
Time, 21st December, 1942. New York.

COPRA NOTES.

By C. HARVEY, B.Sc., A.I.C.T.A.,
Senior Agricultural Officer.

1. GRADING SUMMARY, 1942.

THE following table shows the total number of bags graded at each point during 1942 and also the proportion in each grade. It will be noted that very nearly half of the total is of Plantation grade. The total approximates to 16,300 tons, and if the Rotuma output of 2,135 tons (all of Plantation grade) is added the proportion of Plantation is just over half of the Colony's production.

Prior to the commencement of grading at Savu Savu in late June the Savu Savu copra was all graded at Levuka and included in the Levuka returns.

This table corrects the figures for March 1942, Levuka, which were wrongly given in the table on p. 35, No. 2 of Vol. 13 of this *Journal*.

Place.	Month.	Total No. of bags presented for Grading.	Number of Bags.		Percentage.	
			Plantation.	F.M.S.	Plantation.	F.M.S.
1942.	January ..	2,399	798	1,601	33	67
Suva ..	February ..	5,423	4,816	607	89	11
	March	3,919	3,369	550	86	14
	April	8,728	5,978	2,750	68	32
	May	10,247	6,340	3,907	62	38
	June	10,868	8,625	2,243	79	21
	July	13,677	11,116	2,561	81	19
	August . ..	17,854	12,597	5,257	70	30
	September ..	10,289	4,820	5,469	47	53
	October ..	17,189	120,160	5,173	70	30
	November ..	13,818	12,132	1,686	90	10
	December ..	7,491	5,657	1,834	76	24
	Total ..	121,902	88,264	33,638	72	28
1942.	January ..	4,917	1,870	3,047	38	62
Levuka ..	February ..	3,625	1,829	1,796	50	50
	March	7,387	1,515	5,872	21	79
	April	7,874	952	6,922	12	88
	May	9,127	1,025	8,102	11	89
	June	11,306	975	10,331	9	91
	July	8,974	1,980	6,994	12	78
	August . ..	11,223	2,395	8,828	11	79
	September ..	10,550	1,671	8,879	16	84
	October ..	12,301	2,841	9,460	23	77
	November ..	14,120	4,900	9,220	35	65
	December ..	16,376	6,813	9,563	42	58
	Total ..	117,780	28,766	89,014	24	76
1942.	January–May ..	....	.....	....	....	....
Savusavu ..	June	119	5	114	4	96
	July	1,148	54	1,094	5	95
	August . ..	471	9	462	2	98
	September ..	928	104	824	11	89
	October ..	696	175	521	25	75
	November ..	892	238	654	27	73
	December ..	678	101	577	15	85
	7 months	4,932	686	4,246	14	86
	Grand total ..	244,614	117,716	126,898	48	52

2. ORIGIN OF COPRA.

Records of copra received at grading points during 1942 show that the copra producing areas contributed to the total in the following proportion:—

Taveuni	24 per cent	Viti Levu, Kadavu and Yasawas ..	7 per cent
Lau	16 ,,	Rotuma	12 ,,
Vanua Levu . ..	37 ,,		
Lomaiviti	4 ,,		

OBITUARY.

Mr. E. Duncan.

It is with regret that the death is recorded of Mr. Edward Duncan of Suva on 9th February, 1943.

Mr. Duncan was born in Scotland in 1864, completed training for the bank in Scotland and came to Fiji in 1886 to join the Colonial Sugar Refining Company.

He served the Sugar Company as an accountant for one year and then joined the field staff. He became Deputy Manager at Ba, 1890, acted Manager for a year, then became Deputy Manager at Nausori and finally in 1897 became Manager at Labasa and continued in that post until 1910. He then joined the Vancouver-Fiji Sugar Company until be retired in 1917. Thereafter copra production was his chief interest in the Colony and by example and precept be continuously sought to improve the quality of Fiji copra and to better the financial position of the industry.

On Mua, his own plantation on Taveuni which he bought in 1910, he designed and established a large capacity copra kiln which for many years continued consistently to produce excellent quality copra. He introduced the Malayan dwarf type of coconut into the Colony and saw them come into full bearing on his own estate four to six years earlier than the local ordinary type of palm.

As Chairman of the Coconut Planters' Union for nearly twenty years and as a member of the Levuana Committee throughout its existence he exercised a powerful influence on the local copra industry and his advice was always sought by Government and others in all matters appertaining to copra production.

He was also deeply concerned with stock, especially cattle and sheep raising and frequently imported valuable stock from adjacent countries for the purpose of the improvement of local types. He was largely instrumental in the selection of the Tailevu area as a suitable site for dairy farming for soldier settlers after the last war and thus played an important part in the establishment of the present butter industry.

In 1909 Mr. Duncan was appointed a Justice of the Peace and was an elected member of the Legislative Council from 1914 to 1917.

His expert knowledge of the two main industries of Fiji together with his long experience in the Colony coupled with the high respect in which he has always been held, enabled him to render most valuable service to the Colony over a lengthy period of years and he will long be remembered.

Sincere sympathy is felt for his wife and the members of his family in their great loss.

(Acknowledgment is made to the *Fiji Times and Herald*, from which information has been freely drawn in the above note.) —H.W.J.